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# Habitat Relationships

## *Use of Forage Areas*

OBSERVATIONS OF BISON use of forage areas indicated preferred locations and vegetation types and suggested resulting influences on the populations. These were most apparent in winter. Forage availability did not appear to be a population-limiting factor most of the time. Conditions under which forage might be a limiting factor were suggested but not established by this study. Bison, in turn, influenced their foraging areas (see Effects on Habitat). Grasses and grasslike species which commonly occur in some forage areas are listed in Appendix VII.

During the winter, most bison concentrated on sedge sites for their forage. At Soda Butte in Lamar, 30 or more bison concentrated at times, and a few to a dozen bulls stayed all winter long. Elsewhere in Lamar, mixed herd use concentrated along Slough Creek sedge bottoms and in the many sedge swales west of the Lamar Canyon. Within the main or lower Pelican Valley, study records showed that herd use was constant, much of every year, along the Pelican Creek bottoms where snow depths permitted. In Hayden Valley, some years, the mixed herds were seen almost all of the time along Alum Creek in the vicinity of Violet Creek. In the Lower Geyser Basin, the extensive sedge meadows of Sentinel Creek, Fairy Creek, and Fountain Flats were used most of the time by most of the animals. Use of these sedge areas was facilitated by the ability of bison to forage in deep snow (previously mentioned), and the influence of thermal activity on some of the sites (see Use of Thermal Areas).

Use of specific upland sagebrush-bunchgrass areas on the winter ranges apparently varied more from year to year. In 1965-66, on aerial observation flights, animals were observed most frequently on the north side of Pelican Creek, at the lower end of Astringent Creek, and to the west for 2 miles. The next year they were usually observed on the slopes of the southeast edge of the valley, in the vicinity of the old bridge over Pelican Creek. A third year they

were in the east end of the valley. Only three times during 30 years of ranger ski patrols and once during the present study were mixed herds seen at the Mushpots-Mudkettles area of the upper valley in winter, although they crossed this area in spring. In Hayden Valley one year, the herd groups, when not on Alum Creek, ranged the north-facing slopes of the hills on the south bank of Alum Creek. Another year they were located more frequently another mile or more south, on the slopes and knobs in the southwest corner. Such differences in use of specific sites also existed on the Firehole and in Lamar. Presumably, varying patterns of snow drifting, crusting, and melting which affected forage availability influenced these shifts of use on upland sites.

During spring, summer, and fall, bison use of forage areas concentrated less on any one place or type. Use of sagebrush-bunchgrass sites increased particularly in the spring, but during all three seasons bison were more commonly seen on swales and lusher meadows where sedge species composed much of the vegetation, even at high elevations. Use of forested sites for feeding was usually limited to the more open growth and seemed incidental to other influences (rutting activity, shade needs, escape cover, travel, escape from insects). At no time did forage appear limited during these seasons, either for the present populations or for the higher populations of the past.

Observations indicated that although bison migrations between winter and summer ranges were not caused by forage conditions, less extensive movements were influenced by changes in plant growth. During the summer, with the additional influence of biting insect populations, bison moved on upward on the summer ranges as the spring season reached higher elevations. Movement among the main use areas of swales and lush spots was considerable, probably because these places were usually small in extent and widely scattered, although numerous. Local movements at all seasons appeared influenced by interspersion and size of foraging sites.

Information obtained during the present study did not indicate population levels at which severe winter conditions might limit the forage available from the complex of sedge and upland sites. Present observations were limited to relatively low population numbers and were made during mild and average winters. Observations and information from the present study and earlier did suggest that bison numbers were related to use of specific thermal sites during extreme winter conditions. Bison use of these sites may result from a combination of temporary forage limitations on the preferred sedge and upland sites, the ability of bison to reach these sites, and the

direct physical influences of prolonged cold or storm conditions. Forage in these sites appeared quite limited; thus these sites may be a population regulation mechanism influencing mortality according to the numbers of bison forced to use them and the length of time they stay.

## Use of Thermal Areas

Bison utilized wintering sites which were influenced by the widespread thermal activity in the park. The amount of use varied with the size of the bison group (solitary bulls, bull groups, mixed herd groups) and the kind of thermal influence. Thermal activity refers to sites where thermal features (geysers, hot springs, fumaroles) are located. The ground at these sites is usually snow-free to some extent, and streams into which the features discharge hot water may remain as ice-free travel routes for some distance from the activity. Additionally, there are places where there may be no thermal features but warm ground results in small snow-free areas or larger areas where snow does not accumulate as deeply as it would without the thermal influence (Figs. 38-41).

One to several bulls used sites of thermal activity (Fig. 42) more

**Fig. 38.** Snow-free bison feeding site on warm ground at the edge of Fairy Meadows in the Firehole.

**Fig. 39.** The same site shown in Fig. 38, in early summer.

than larger bull groups and mixed herd groups did, but these sites were not used by a majority of such bulls. Scattered bulls were habitually found at various places in the Firehole, at the Mud Volcano in Hayden Valley, at Soda Butte in Lamar, and at satellite areas such as Ponuntpa Hot Springs, Violet Springs, and Mary Bay in the Pelican country. But more than half of the bulls which wintered apart from the mixed herd groups were located where there was neither thermal activity nor the influence of warm ground. Both Lamar and Hayden Valley had proportionately more of the

**Fig. 40.** Site along Alum Creek in Hayden Valley where warm ground causes snow to melt early.

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**Fig. 41.** The same site shown in Fig. 40, in summer.

total number of the wintering bulls, as discussed previously. In both valleys, most of the solitary bulls and bull groups were observed apart from any site of thermal influence.

Herd groups were seldom seen at sites of thermal activity but often used areas of thermal influence, particularly sedge bottoms where snow depths were less (junction of Alum and Violet creeks in Hayden Valley (Fig. 43), Pelican Springs area of Pelican Valley, Lower Geyser Basin areas on the Firehole). They used open streams such as the Firehole River, Alum Creek, and parts of Astringent Creek (Pelican) for travel (Fig. 44), and fed on the sedge growth of the banks while in the water (Fig. 45). Only in Lamar, of the four main wintering valleys, were thermally influenced places little used by mixed herd groups; thermal activity is least there (except Soda Butte).

**Fig. 42.** Bison bull wintering among active geysers and hot springs.

**Fig. 43.** Aerial view of the Alum Creek winter feeding area. Snow depths are less in the darker places along the creek because of warmer ground.

**Fig. 44.** The Firehole River is open all winter because of an influx of hot water from geysers and hot springs along the banks. Photo by Karl Bittler.

**Fig. 45.** Sedge growth along the banks of the Firehole River provides forage for bison and elk moving in the open water.

Total use by all bison of areas where thermal influence alleviated otherwise more severe winter conditions involved was more than the use of thermally active sites. In the Hayden, Pelican, and Firehole valleys, the amount of use of sedge bottoms with lessened snow depths, and of ice-free streams, indicated that thermal influence was important in maintaining wintering populations. In Lamar, where winters are comparatively less severe, the lack of thermal influences may not affect numbers of bison which can winter there.

Observations both before and during the study period indicated that specific sites of thermal influence where small, warm, snow-free patches occurred, sometimes in conjunction with the activity of a few hot springs or fumaroles, were of great importance to the bison population during brief but critical periods. During the prolonged very cold spells of the severe winter of 1955-56, Jim Stradley (1968 pers. comm.) observed mixed herd groups in the scattered small, warm areas west of Astringent Creek in the Pelican area, in the Mud Volcano area of Hayden Valley, and just east of the Firehole River (Pocket Basin) in the Lower Geyser Basin (Firehole). During the study, herd groups were seen in these same Astringent Creek areas of Pelican (Fig. 46) late one winter (1968) after a stormy period and presumably were there the few other times

**Fig. 46.** Bison in one of the scattered small thermal areas west of Astringent Creek in the Pelican country.

they could not be located in the usual places. Winters (except 1964-65) were not severe during the study period, and mixed herd groups were not observed at Mud Volcano nor in Pocket Basin. The areas were not preferred by the herd groups, since use apparently was restricted to periods of severe conditions or late winter. Forage appeared very limited in these areas and the period of use was usually very brief—a few days or perhaps a week. In spite of very limited use, these areas probably represent the margin for survival of the herd groups in Firehole, Hayden, and Pelican valleys during the most extreme winter conditions.

## *Effects on Habitat*

Effects on habitat as observed throughout the study period were considered from two points of view: those which seemed to occur even under low population densities of bison, and those which might have resulted from an ecological imbalance and overpopulation by bison. Bison caused or contributed to five kinds of impact on their habitat: debarking of trees, formation and maintenance of trails and wallows, trampling of sinter rock deposits in areas of thermal activity, and alteration of plant cover.

Trees which were debarked and even girdled by the rubbing and horning of bison in summer were not scattered throughout the bison use areas, but occurred in certain localities, apparently favored by both the mixed herds and the scattered bulls. In extensive areas of lodgepole pine forest on the south side of Hayden Valley (Fig. 47), in groves on the lower end of the Cache-Calfee ridge, and at a few sites on the Mirror Plateau, nearly every tree had been rubbed to some degree. Elsewhere, very small groves of trees located far from the normal summer range of the mixed herds also showed hard use, apparently by one or more of the separated bulls. Rubbing occurred during the period of shedding and regrowth of hair, when biting insects were sometimes numerous, and extended on

**Fig. 47.** Nearly every tree in this part of the lodgepole forest at the south edge of Hayden Valley has been debarked to some extent by rubbing bison.

through the rut. Horning of trees by bulls, more specifically associated with rutting activity, had even more effect than rubbing (Fig. 48). Although many trees survived years of this use, isolated trees and those near the edges of the forest were often killed. McHugh (1958) found that in rare cases in Hayden Valley the tree line was actually forced back, but that overall effects on reproduction were minor. Patten (1963) concluded that elk contributed to maintenance of an abrupt ecotone between forest and meadows in the Madison Range (just west of the park) but that forest areas were increasing slowly. Similarly, the bison might impede, but not stop, the invasion of the meadow areas by the forest, which appears to be occurring.

Wallows, particularly those located in places where summering bulls commonly stayed or traveled, were used year after year. Wallows were as much a feature of these areas as were the bison themselves (Fig. 49). Even after areas such as Blacktrail Deer Creek were uninhabited by bison for a number of years, the depressions left by the

**Fig. 48.** Bison horning effects on a lodgepole pine.

wallows could still be discerned, although no differences between the vegetation within and around the depressions were apparent. When situated on slopes, wallows sometimes formed focal points of erosion, particularly in the shallow sandy soils of the hills in the southwest part of Hayden Valley. The presence and continued use of such sites did not appear to be related to population levels; some of these places were used before the present study (Kittams 1949) and show no change in spite of greatly reduced bison numbers. Bulls were commonly seen every year and at all seasons on some of these sites, which suggested that as long as any bison inhabited Hayden Valley these favored places received heavy use. Revegetation of favored wallows might occur only without a bison population.

Trails used by bison, such as the network within Hayden Valley (Fig. 50) and those connecting main use areas such as the Mirror Plateau and Upper Lamar, were also features which appeared only indirectly related to population numbers. These routes were used historically, as now, because of habits and distribution patterns.

Areas of thermal activity used by bison, where hot pools and geysers are located, sometimes show breakage of sinter deposits by trampling. Because the rock deposits form slowly, the effects may be apparent for years. Mixed herd groups used such areas infrequently and for brief periods, according to the severity of wintering conditions, as discussed previously. Some wintering bulls used certain thermal areas throughout the winter every year regardless of changes in bison numbers.

Locations where debarked trees, wallows, trails, and trampling of thermal areas were most noticea-

**Fig. 49.** Bull bison at a wallow which is used year after year.

ble were in the Firehole-Hayden Valley part of the park. Before the present study, during the much higher bison populations of the mid-1950s, these effects caused considerable concern. The impact of the presence of bison was obvious, and may have seemed especially striking because bison (except perhaps a few strays) had been absent from that area for at least 35 years and had not been present in any numbers for at least 50 years. Then, over a span of about 15 years, the marks of bison habitation became suddenly apparent, and increased rapidly as the population expanded into this uninhabited section. The resulting concern was understandable, but perhaps exaggerated.

Observations made during the study period indicated that debarked trees, wallows, trails, and trampled thermal areas were all effects which occurred at locations favored by bison for specific activities. The amount and distribution of such effects might increase somewhat at higher population levels, but not to the same extent as the numerical increase. An assessment of such effects would not provide an indication of what a desirable bison population should be in Yellowstone.

Bison effects on plant cover were apparent on foraging areas of the winter ranges where habitat use is restricted by winter conditions. Observations indicated that effects on summer range from use by the wide-ranging bison appeared less important than influences from climatic factors (late-melting snow patches, late springs, short growing seasons) and edaphic influences (slope, soil, exposure).

During the present study, evalu-

**Fig. 50.** A bison trail, one in a network connecting the most-used parts of the Hayden Valley area.

ations made of range conditions in Lamar, Pelican, and Hayden valleys by the Soil Conservation Service (1963, 1964) indicated large areas of upland (usually steeper slopes and southwest exposures) in the poor and fair condition classes, producing less than 25% and 26-50%, respectively, of potential or climax vegetation. Soil erosion and disturbance (particularly in Pelican and Hayden valleys) by animal trampling and rodent activity was noted. Wetlands and subirrigated (a range classification term for some naturally occurring moist sites) lands were in good to excellent condition. The condition of these wintering valleys was attributed to use by elk and, particularly in Pelican and Hayden valleys, to winter use by bison. An evaluation of the Firehole was not made by Soil Conservation personnel, but general observations indicated that essentially the same conditions prevailed.

The effects which bison had on the vegetative cover of the winter ranges they inhabited, as the above surveys showed, were mostly confined to upland sagebrush-bunchgrass sites. Both the surveys and the present study indicated that the sedge-producing wet bottomlands and swales showed little effect. Observations made during the study indicated that bison use, particularly by mixed herd groups, occurred most frequently and for longer periods on these wet sites, which were the main source of forage. The condition of the less-used upland areas suggested that these sites were particularly vulnerable to impact and might

remain in such condition in spite of varying patterns of use. Cole (1969) suggested that free-ranging elk would maintain upland areas in similar condition, which he termed biotic disclimaxes.

Information on the quantity and composition of the forage resources of the thermal sites used by mixed herd groups under extreme winter conditions has not been obtained. Use of these areas in stress circumstances (which occurred infrequently) rather than by preference suggests that although the forage resources appear very limited, the duration and intensity of use do not permit destruction of the vegetation.

Several considerations suggest that the effects of bison use on winter ranges, clearly apparent on upland sites, may not be greater than those which prevailed at the time the park was established. First, the habitat of the main wintering valleys (except Lamar) has been little altered by the activities of man, although animal numbers and distributions have been changed. Second, although the actual numbers of bison which originally inhabited the park area throughout the year are not known, information from this study indicated that present numbers, and those for much of the park's history, have been less than the original populations which apparently centered on the various winter ranges.

Pelican Valley may indicate the extent to which present conditions represent the past. A bison population has wintered there annually since the park was established (and probably long before), it has been least disturbed by man (reductions), and historical sources provide limited information on early habitat conditions. Jones (1875) wrote:

> This prairie is the home of great numbers of field mice and moles [pocket gophers], which have burrowed up the ground to such an extent that it is traveled over with difficulty.

The same comment could be made today, which suggests that the appearance of Pelican Valley has changed little, regardless of the cause of that appearance. If the cause (bison use) has not changed appreciably, present conditions in Pelican Valley may approximate those which prevailed at the time the park was established.

The extent to which conditions resulting from bison use of the other wintering valleys may yet resemble those of early times is less clear. In Hayden Valley, range surveys (Kittams 1949; Soil Conservation Service 1964) attributed retrogressive changes in plant cover on upland sites primarily to the effects of bison use. The absence of many bison for nearly 50 years apparently permitted a trend toward climax vegetation; subsequent repopulation caused marked retrogression which may represent reestablishment of con-

ditions which were prevalent with use by the original bison population. Conditions resulting from use by bison in the Firehole may be comparable.

In Lamar, present effects of bison use probably represent more of a departure from early conditions. Habitat disturbance by man has been greater, bison populations were maintained in semidomestication for many years, and the area provides winter range for a more diversified ungulate population (elk; bighorn, *Ovis canadensis;* moose). The extent to which bison use and resulting effects may overlap with that of other ungulates on this range is presently being studied (William Barmore 1969 pers. comm.). Present low bison numbers contribute minimal effects on vegetative cover compared with other influences, and have much less impact than in historic times.